

**NASA BALLOON PROGRAM
NATIONAL SCIENTIFIC BALLOON FACILITY
GROUND SAFETY PLAN**

1.0 Introduction of the NSBF Balloon Ground Safety Plan

1.1 General

1.1.1 This document is the Balloon Ground Safety Plan (BGSP) for operations performed by the National Scientific Balloon Facility (NSBF). The BGSP is a subsection of the Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF) identified as RSM-93.

1.1.2 The NSBF GSP applies to all balloon operations performed by the NSBF Department personnel at Palestine, TX, Fort Sumner, NM, or any remote launch site.

1.1.3 The ground safety goal of the NSBF GSP is to minimize risks of injury or death to personnel and damage to property caused by NSBF in conducting operations, and to prevent mishaps that might result in embarrassment to NSBF, NASA, and the United States Government.

1.1.4 It is the policy of the GSFC/WFF and NSBF that all systems be designed such that a minimum of two independent unlikely failures must occur in order to expose personnel to a hazard.

1.2 Responsibilities

1.2.1 It is the responsibility of the NSBF Operations Department Head (Campaign Manager, at remote sites) to insure compliance with the provisions of the BGSP for NSBF operations and for science user operations. The NSBF Recovery Leader is responsible for safety during recovery operations.

1.2.2 It is the responsibility of the NSBF science user to supply NSBF with documentation identifying hazards and control methods to rate the severity (catastrophic, critical, marginal, or negligible); to specify the probability (frequent, probable, occasional, remote); and to supply operational procedures which minimize the risk of injury to personnel. Hazards will be identified in the science user flight request and reviewed at the NSBF Flight Requirements Meeting. This meeting occurs when the science user arrives at the launch site staging area.

2.0 **Hazard Control**

2.1 **Hazard Categories**

2.1.1 Hazard categories used in the BGSP correspond to the definitions in RSM-93 paragraphs 5.2.5.1 (Category A) and 5.2.5.2 (Category B).

2.1.2 The NSBF balloon flight system contains no inherent Category A hardware, equipment, or systems. The only explosive or pyrotechnics in the NSBF flight systems are totally contained pyrotechnic wire cutters or pyrotechnic separation devices, which are considered to be Category B devices.

2.1.3 Conditions exist during various phases of balloon operations for configurations of non hazardous systems or non hazardous systems plus Category B systems to create a situation resulting in a Category A hazard condition.

2.1.4 All Category A hazard conditions will be directly addressed within the NSBF BGSP identifying the steps taken to mitigate risk to personnel and property.

2.2 **Hazard Control Methods**

2.2.1 The methods employed by NSBF to protect personnel and to minimize risk while conducting potentially hazardous operations will be to:

- Implement safety design criteria
- Identify all the known hazards associated with the program
- Minimize exposure of personnel to potentially hazardous systems
- Establish safe operating procedures
- Plan for contingencies.

2.2.2 **Exposure Limits**

2.2.2.1 The principle used in conducting balloon launch operations and exposing personnel to a hazardous situation is to limit the exposure to a minimum number of personnel for a minimum number of potential hazards consistent with safe and efficient operations.

2.2.2.2 Operations will be configured that, should an incident occur, it will cause the least possible injury to personnel and property.

2.2.2.3 Operations will be conducted in such a manner that the exposure of personnel to a potential hazard decreases as the probability of an incident increases.

2.2.3 **Personnel Limits**

2.2.3.1 The designated NSBF Launch Crew Chief is responsible for determining that only active essential personnel are permitted within potentially hazardous areas during a balloon launch operation.

2.2.3.2 The normal limit of operational personnel within the hazard area prescribed for the balloon launch area is 12. The number of personnel at any given time within the hazard area will be kept to a minimum. The Flight Director for NSBF Operations or the NSBF Campaign Manager at remote sites may grant exceptions as requests are presented.

2.2.3.3 Requirements regarding official visitors, guests, tours, etc., are as follows:

No guests, tours, or visitors will be allowed within any hazardous area after a hazardous operation has been initiated.

All guests, tours, or visitors observing any part of the launch operation will be escorted by a NSBF employee as approved by the Flight Director for operations at the NSBF, or the Campaign Manager for operations at all other locations. The escort will assure that all non-operational personnel remain outside hazardous areas when hazardous operations are underway.

3.0 **Specific Policies**

3.1 **Operational Phases**

3.1.1 Operational activities associated with balloon launches are divided in four phases. These phases are not necessarily continuous in time. Specific hazards may occur in each phase. The following paragraphs define the four phases and identify the specific procedures required in each phase to mitigate risk.

3.1.2 Phase I - General Operations Support

This phase is associated with receipt, inspection, storage, and shipment of materials to and from NSBF or remote sites; moving about the launch site; pre-

flight preparation, assembly, and testing; and recovery operations to include transportation systems back to the launch site.

3.1.3 Phase II - Payload Pickup Through Start of Inflation

This phase extends from the time that the payload is physically attached to the balloon launch vehicle prior to leaving the assembly area to the point that inflation of the balloon commences.

3.1.4 Phase III - Balloon Inflation

This phase starts when lifting gas is applied to the balloon, after it is connected to the complete flight system. The phase is complete when all lifting gas has been transferred to the balloon and all pre-flight preparations are complete.

3.1.5 Phase IV - Launch

This phase starts from the time the balloon is released from the spool and ends when the payload is released from the launch vehicle.

3.2 **Specific Policies and Criteria**

3.2.1 **Phase I - General Hazards**

3.2.1.1 **Ionizing Radiation Controls**

3.2.1.1.1 All operations involving the use of radioactive sources must conform to the standard of the Nuclear Regulatory Commission, 10CFR, and applicable regulations for the state or country in which the operation takes place. Radioactive sources used in-flight are subject to NASA approval. A written request for approval must be submitted to the NASA Balloon Program Office as early as possible, but no less than one year prior to the mission. Written requests must identify the source type, quantity, activity levels, and planned schedule for use.

3.2.1.1.2 The NSBF Radiological Safety Officer (RSO) shall be responsible for receiving and providing appropriate storage for all radioactive sources brought to NSBF and remote sites. Procedures for the use, handling, and storage of radioactive sources shall be designed to minimize the exposure of personnel. All activities will comply with the specific procedures and policies identified in the NSBF Health and Safety Plan.

3.2.1.1.3 The scientific user is responsible for obtaining all licenses for radioactive material,

and for supplying the NSBF RSO with copies of the licenses.

- 3.2.1.1.4 Range users will provide the NSBF RSO with Material Safety Data Sheets for each source being used.
- 3.2.1.1.5 For operations conducted from Alice Springs, Australia, the University of New South Wales will maintain a set of calibration sources for use by scientific users of the facility. The University of New South Wales will be responsible for maintaining the appropriate licenses and documentation, as well as for storage of the sources.
- 3.2.1.1.6 For operations conducted from Antarctica, the National Science Foundation will provide the necessary licenses, documentation, and storage for all radioactive sources transported to Antarctica.
- 3.2.1.1.7 Removal of ionizing radiation sources from NSBF or remote launch sites is the responsibility of the range user, except for special cases specified in 3.2.1.1.5 and 3.2.1.1.6.

3.2.2 **Laser Hazards Control**

- 3.2.2.1 All operations involving the use of lasers must comply with the standards and regulations of ANSI Z136.1-1096 and GHB 1860.3
- 3.2.2.2 Access and laser illumination must be controlled to insure that no personnel are present within the ocular hazard area unless suitable protection is provided per NASA/GSFC Handbook for Radiation Safety-Laser GHB 1860.3A (May 1978) and ANSI Z-136.1-1986.

3.2.3 **Chemical Hazards**

- 3.2.1.1 Chemical Hazards can almost exclusively be categorized into those associated with handling of cryogenic materials, gases, and lithium used in batteries. Chemical hazard control is largely the responsibility of the scientific user with NSBF oversight responsibility per paragraph 1.2.
- 3.2.3.2 It will be the responsibility of the scientist to develop procedures for the safe storage, handling, transfer, and uses of hazardous cryogenic materials, gases, and solids brought to NSBF or any remote launch site on behalf of the scientist or for use in balloon payloads. Hazards, hazard areas, and procedures for safe operations will be reviewed and approved by the NSBF FSO.
- 3.2.3.3 Hardware (tanks, transfer lines, etc.) shall conform to applicable ASME and DOT

regulations.

- 3.2.3.4 Science users will supply the NSBF Officer or Campaign Manager with Material Safety Data Sheets (MSDS) for all hazardous material. The NSBF Safety Officer or Campaign Manager will have knowledge of physical and health hazards, as well as first aid techniques relevant to the hazardous material operation. MSDS's will be posted in applicable work areas at the primary work place facility. When NSBF employees are at remote locations, required information can immediately be obtained by voice communication with the NSBF FSO.
- 3.2.3.5 The NSBF Safety Officer or Campaign Manager will develop a special ground safety plan if danger to personnel associated with the hazardous material falls outside the normal controls associated with materials used in balloon operations.
- 3.2.3.6 Handling and storage of lithium batteries will be performed in compliance with NSBF Operations Department policies to include protective clothing and equipment requirements.
- 3.2.3.7 Disposal of lithium batteries shall be coordinated with the NSBF Facility Safety Officer and comply with local codes and regulations.
- 3.2.3.8 All work areas are carefully inspected for unrecognized hazards. OSHA 1910.146, "Permit Required Confined Spaces" will be a guide in all NSBF operations associated with confined spaces.
- 3.2.3.9 When handling chemicals, gases and lithium batteries, adequate personnel protective equipment will be worn to reduce the risk of personal injury. When chemical spills occur, trained personnel will respond in compliance with NSBF "Chemical Spill Procedure" as described in NSBF Safety and Health Plan.
- 3.2.4 **Pressure Vessels**
 - 3.2.4.1 All ground support pressure systems shall meet ASME Boiler and Pressure Vessel Codes or GMI 1710.4.
 - 3.2.4.2 All helium trailers and isopaks used in balloon operations shall comply with applicable DOT regulations.
 - 3.2.4.3 Unrestricted access will be granted to all pressure systems that are certified to the ASME Boiler and Pressure Vessel Codes or have stored energy levels less than 100 K Joules (75K ft-lbs) and operating pressure less than 150 psi for gases and 1500 psi for liquids.

3.2.4.4 Airborne systems will be identified per 1.2.2 by the NSBF science user. The NSBF FSO will review the systems and hazards identified by the science user. Of airborne pressure systems do not comply with ASME Boiler and Pressure Vessel Codes or GMI 1710.4, the NSBF FSO will coordinate with the science user to determine compliance within NASA GSFC safety guidelines.

3.2.4.5 A special Ground Safety Plan and data package will be prepared for operations involving pressure vessels or systems which do not meet criteria specified 3.2.4.1. This Ground Safety Plan will identify hazard areas and include provisions for separating personnel from the pressure vessels by a barrier designed to protect against blast and fragmentation within the hazard area.

3.2.5. **High Voltage**

3.2.5.1 NSBF systems do not utilize high voltage electronics.

3.2.5.2 Any science user creating high voltage hazards will be identified under Paragraph 1.2.2. The NSBF FSO and NSBF Operations Manager will review any identified high voltage hazards and determine that the scientist complies with NASA GSFC safety requirements.

3.2.6 **Pyrotechnics**

3.2.6.1 NSBF does not utilized high energy pyrotechnics. NSBF does utilize Electro-Explosive Device (EED) cable cutters and separation devices (explosive1.45 DOT 172.101, CFR 49) on NSBF flight and payload systems. NSBF technicians, responsible for wiring and assembly of equipment using EED cable cutters, receive training and orientation by the NSBF FSO on proper handling and assembly of these devices in NSBF flight systems.

3.2.6.2 Any pyrotechnic hazards identified in science user systems will be identified under 1.2.2. The NSBF FSO and NSBF Operations Manager will review any identified pyrotechnic hazards and determine that the scientist complies with NASA GSFC safety requirements.

3.2.7 **Packaging and Shipment of Hazardous Material**

3.2.7.1 All shipments of hazardous material shall be packaged and transported in compliance with DOT regulations, transportation regulations for the appropriate foreign country, if applicable, and relevant instructions listed on the materials safety data sheets.

3.2.7.2 The NSBF Safety Officer, shipping/receiving clerk, and NSBF Property Officer shall be responsible for compliance with applicable regulations.

3.2.8 **Moving About and Working at the Launch Site**

3.2.8.1 NSBF employees, visitors, and scientific users shall comply with all posted speed limits and cautionary signs while at NSBF and remote sites.

3.2.8.2 It shall be the responsibility of the NSBF Safety Officer to identify potential hazards associated with everyday activities at NSBF facilities, and post the appropriate warnings appropriately. At remote sites this function will be the responsibility of the NSBF Campaign Manager.

3.2.8.3 Heavy equipment, i.e., launch vehicles, spool vehicles, etc., will be limited to a maximum speed of 5 mph while moving about NSBF facilities.

3.2.8.4 NSBF employees, scientific uses, or visitors shall not operate machine shop equipment, the BEMCO chamber, or Tenney Chamber without express approval from the respective area supervisors. Permission to operate this equipment shall be granted after the user demonstrates proficiency with the equipment, and knowledge of applicable safety procedures.

3.2.9 **Recovery Operations (reference NSBF Policy # 4-74-2, “Balloon Tracking and Recovery”)**

3.2.9.1 All NSBF recovery trucks and trailer assemblies shall comply with applicable DOT regulations, as well as state and local codes pertaining to operation of motor vehicles.

3.2.9.2 Prior to each balloon operation, an NSBF recovery form shall be completed by the scientific user delineating specific hazards and safety procedures associated with pickup, disassembly, and transportation of the instrument back to the launch site. It shall be the responsibility of the NSBF Safety Officer or his designee to insure that information on the form is complete. This form will be reviewed in detail prior to departure so that NSBF recovery personnel are familiar with any hazards that may be associated with recovery. In the area of unusually hazardous recoveries, a special recovery plan will be prepared.

3.2.9.3 Whenever possible, a representative of the scientific group will accompany the NSBF recovery crew to aid in preparing the payload for safe transport back to the launch site. The NSBF Safety Officer or is designee will require scientific participation in recoveries deemed unusually hazardous.

- 3.2.9.4 Lithium batteries will be disconnected and stored in approved shipping containers prior to transport. Batteries will not be disposed of in the field by burial, but will be transported back to the launch site for proper disposal.
- 3.2.9.5 Pressure vessels and cryogenic dewars shall have pressure relieved and be rendered safe prior to transport according to instructions on the recovery form.
- 3.2.9.6 Protective clothing and equipment will be worn by recovery personnel consistent with the hazards associated with each recovery.

3.3 **Phase II - Payload Pickup to Start of Inflation**

3.3.1 **Heavy Equipment Operation**

- 3.3.1.1 It will be the responsibility of the Crew Chief to direct the movement and operation of all heavy equipment used in balloon launch operations in such a way as to insure safety and minimize the number of personnel exposed to hazards associated with this equipment.
- 3.3.1.2 All NSBF lifting devices, fixtures, and equipment must conform to NSS/G01740.9B as a NASA facility under GSFC/WFF management.
- 3.3.1.3 All crane type launch heads using pins to suspend the payload, will have two rated safety cables attached between the launch head and the truck plate to restrain the truck plate.
- 3.3.1.4 **Tiny Tim Launch Vehicle**
 - 3.3.1.4.1 While attaching the “Tim” fitting to Tiny Tim, the vehicle’s engine will be shut off. The generator attached to the engine is the only energy source to the motors used to activate the jaws holding the payload or controlling the launch boom.
 - 3.3.1.4.2 No personnel will be permitted to walk out onto the jaws of Tiny Tim (painted red area) while the engine is running.
 - 3.3.1.4.3 The hydraulic operated safety column will be used as a secondary support for the launch boom at all times when a payload is suspended from the jaws of Tiny Tim.
 - 3.3.1.4.4 Regular inspections of Tiny Tim will be performed according to procedures outlined in NSBF Operations Policy #08-92-31, “Inspection of Tiny Tim.”
 - 3.3.1.4.5 A Category A condition occurs when the balloon payload is suspended from Tiny Tim jaws and the Tiny Tim engine is running.

- 3.3.1.4.5.1 The hazard area for this Category A condition is defined as the ground footprint of the science payload.
- 3.3.1.4.5.2 No personnel will be allowed in this hazard area for any reason when the Category A condition exists.

3.4 **Phase III - Hazards-Balloon Inflation**

3.4.1 **Mechanical Constraint of Flight Train**

- 3.4.1.1 The NSBF Support Engineering Department will be responsible for providing mechanical certification of the spool, spool restraining vehicle, flight train, and launch vehicle for each launch configuration used at NSBF and remote sites. Guidelines for certification will be to insure mechanical integrity of the entire system at the maximum planned gross inflation should the system be exposed to a 20 knot wind directly behind the balloon bubble at the completion of inflation.
- 3.4.1.2 NSBF Launch Crew Chief is responsible to configure all launch equipment in accordance with the approved mechanical certification provided by the NSBF Engineering Department.

3.4.2 **Electro-mechanical Constraint of Flight Train**

- 3.4.2.1 Category A hazard condition results when the NSBF Flight Terminate System is made “hot” by insertion of the continuity plug and balloon inflation begins. This Category A hazard continues through balloon launch or until helium is released from the balloon envelope or until the continuity plug is removed the NSBF Flight Terminate System.
 - 3.4.2.1.1 The Category A hazard area is defined as extending from the NSBF parachute cut-away device to the launch spool. This area extends 10 feet on either side of the package and balloon up to the launch spool and a 50 foot radius around the center of the launch spool.
 - 3.4.2.1.2 Personnel will not straddle or remain under any portion of the parachute or balloon at any time when this Category A hazard exists.
 - 3.4.2.1.3 The only personnel allowed within this Category A hazard area are NSBF launch personnel trained to perform the following operations:
 - stripping of protective wrap from the balloon at a position behind the launch spool

- stripping of protective wrap from the balloon from the balloon base fitting to the spool from a position on either side of the balloon
- inspection and documentation of the balloon and associated flight hardware from either side of the parachute and balloon
- installation of the balloon collar by the launch crew chief and support technicians
- deploying the terminate box assembly as slack is taken out of the system during inflation

3.4.2.2 All EED's used for flight critical systems shall meet a 1 amp/1 watt NO FIRE requirement and be 100% qualified with a 500 VDC megohm-meter test for 5 seconds from bridgewire to case (and bridgewire to bridgewire if dual bridgewires are used).

3.4.2.2.1 Electrical wiring and power source shall be completely independent and isolated from all other systems; they will not share common cables, terminals, power sources, tie points, connectors, or ground returns with any other systems.

3.4.2.2.2 All EED's will be connected with approved shorting devices until the flight system is assembled on the launch pad. At no time will any flight system EED's be left in an open circuit condition.

3.4.2.2.3 All EED's will be specified to not give off shrapnel in operation and may be fired without danger of fragmentation.

3.4.2.2.4 All EED's used in balloon operations will be specified as .4S as per CFR 49 for shipment and handling.

3.4.2.2.5 Receiving, shipping, handling, and storage of EED's shall be performed in accordance with NSBF Operations Policy # 04-86-28, "Procedures for Storage, Safe Handling, and Installation of Ordnance Devices".

3.4.2.2.6 All NSBF staff utilized to assemble and install EED's will receive training and orientation by the NSBF FSO.

3.4.3 **Non-ionizing Radio Frequency (RF) Radiation Controls**

3.4.3.1 RF-radiation sources brought to the NSBF or remote sites must pass a compatibility test with NSBF flight systems as performed by the NSBF Electronics Section. Scientific uses will supply the NSBF Electronics Section with specific descriptions of all non-NSBF transmitters or significant RF emitters located on the scientific payload. A Safety Factor (Cs) will be determined based on the calculation in the appendix regarding hazard distance for pyrotechnics.

3.4.3.2 All Operations involving the use of RF transmitters must conform to the standards and regulations specified in ANSI C95.1-1982, and use frequencies approved by the NASA GSFC/WFF Frequency Coordinator, and the designated area frequency coordinator for each launch site.

3.4.4 **Electrostatic Discharge (ESD) Hazards**

3.4.4.1 Precautions must be taken to eliminate or reduce the risk of electrostatic discharge during inflation which could result in actuation of the terminate fitting squibs.

3.4.4.2 The exclusive use of Series 5800 Halex squibs on NSBF terminate fittings greatly reduces or eliminates the potential for inadvertent actuation of the terminate squibs in normal balloon operations.

3.4.4.3 Personnel handling of the terminate box, parachute, and terminate fitting will be minimized after balloon inflation has begun.

3.4.4.4 In extremely dry environmental conditions, the Campaign Manager may opt to apply static dissipating fluid to the ground cloth prior to laying out the balloon.

3.4.4.5 The launch vehicle will incorporate a drag chain to eliminate static charge on the launch vehicle.

3.4.5 **Electrical Storm Criteria (Reference NSBF Operations Policy #8-74-5, "Thunderstorm and Launch Restrictions")**

3.4.5.1 Inflation of a balloon will not be started if an electrical storm is detected within 10 nm of the launch site.

3.4.5.1.1 If no equipment is available to detect electrical storms, inflation will be halted and the hazardous areas cleared upon hearing thunder or observing weather conditions which have an immediate potential of producing an electrical storm.

3.4.6 **High Pressure Gas Equipment**

3.4.6.1 All inflation tubes, fittings, and helium diffusers shall be certified under the GSFC/WFF NSBF Pressure Vessel Certification Program.

3.4.6.2 Hydrogen gas will not be used for balloon inflation except under special procedures that have been specifically reviewed and approved by the NSBF Operations Manager, NSBF Facility Safety Officer, and NSBF Site Manager.

3.5 **Phase IV - Balloon Launch**

3.5.1 **Balloon Release**

3.5.1.1 The Crew Chief shall be solely responsible for signaling the spool operator to release the balloon from the spool. An approved communication mechanism (handy talkie, launch vehicle light system, etc.) shall be employed by the Crew Chief to signal the spool operator to release the balloon.

3.5.1.2 The spool mechanism will be designed such that two actions are necessary to activate the spool and release the balloon.

3.5.2 **Launch Vehicle Safety**

3.5.2.1 The number of personnel riding on the launch vehicle during an operation will be minimized to reduce hazards during launch. A minimum crew will consist of the Crew Chief, Driver, one or two mechanical technicians to push the payload off at launch, and an electronics technician.

3.5.2.2 An electronics technician will ride on the launch vehicle with an approved portable command system capable of terminating the flight upon command from the Crew Chief.

3.5.2.3 An electronic intercom system will be installed on the launch vehicle such that, at a minimum, the Crew Chief, driver and electronics technician have voice communication. This system will be independent from other voice communication systems to eliminate the possibility of interference from other sources.

3.5.2.4 For crane-head launches two safety cables will attach the truck plate to the crane head. The cable release mechanism to launch the balloon will be an NSBF Support Engineering Department approved mechanical lever arm.

3.5.2.5 For Tiny Tim launches, the jaw release mechanism requires two actions to arm the Crew Chief's launch button. On Tiny Tim, a separate jaw release switch will be located in the driver's cab should the Crew Chief's release button malfunction. This switch shall be protected from inadvertent actuation by a hinged cover until immediately prior to balloon releases.

3.5.2.6 The Crew Chief shall be responsible for deciding whether to initiate spool release and balloon launch. If at any point during an operation, the Crew Chief observes conditions that could result in danger to personnel, the decision will be made to

destroy the balloon in the spool or terminate the flight prior to payload release.

3.5.2.7 Balloon collar release will be initiated by command of the Campaign Manager or his designee. The person issuing the command will be located in a safe area off to the side of the operation where the entire flight train is visible. Collar release will take place such that there is no danger of the collar, collar receiver or protective foam striking personnel riding on the launch vehicle.

3.5.2.8 Category A hazard condition exists from the time that the balloon is released from the spool until the payload is released from the launch vehicle.

3.5.2.8.1 The Category A hazard area is defined as a rectangular area on the ground from the payload on the launch vehicle to the launch spool and extending one half of this distance to either side of line between the payload and launch spool. The area also consists of a semicircle in front of the launch vehicle with a radius equal to one-half the length of the total flight system.

3.5.2.8.2 All personnel and vehicles are excluded from this area except for NSBF launch crew personnel assigned to duties on the NSBF payload launch vehicle.

3.6 **HAZARDOUS AREAS**

3.6.1 **Category A Hazard Areas**

3.6.1.1 **Operational Phase II - Payload on Tiny Tim and Engine On**

3.6.1.1.1 A radius on the ground from the center of the science payload equal to the height of the Tiny Tim Pin in the jaws of Tiny Tim.

3.6.1.2 **Operation Phase III - Hot Terminate and Inflation**

3.6.1.2.1 The area from the parachute cut-away device to the launch spool extending one foot either side of the parachute and balloon.

3.6.1.2.2 A rectangular area on the ground from the payload on the launch vehicle to the launch spool and extending one half of this distance to either side of the line between the payload and launch spool. The area also consists of a semicircle in front of the launch vehicle with a radius equal to one-half the length of the total flight system.

3.6.2 **General Restrictions**

3.6.2.1 Operational phases II, III, and IV tend to draw attention from the general public.

Since balloon launch operations rarely occur from locations where access is tightly controlled or limited, crowd control always becomes an issue.

3.6.2.2 The NSBF Operations Manager or his designee will monitor the situation with the general public and insure that vehicles and people are always outside of the launch area in front of the launch vehicle and one-half the distance from the payload to the spool on either side of the parachute and balloon.

3.6.2.3 Visitors may be escorted within these restricted areas by NSBF staff as long as no Category A conditions exist during the operation.

3.7 **Personal Protective Equipment**

3.7.1 Safety glasses or face shields are required for operations that present an ocular hazard, particularly working with lithium batteries and high pressure helium cylinders.

3.7.2 Hard hats are required for operations where personnel work on multiple levels.

3.7.3 Ear plugs are required for all personnel working with 75 meters of the balloon bubble during inflation.

3.7.4 Personnel working with cryogenic liquids shall wear proper protective equipment as necessary including hand and foot protection, face protection, and appropriate outer garments. Pants will be worn outside of boots or shoes while working with cryogenic liquids.

3.7.5 Personnel working with lithium batteries are required to wear appropriate face, body and hand protection. They will also have immediate access to an approved respirator and eyewash station.

3.7.6 Operations involving materials or procedures identified in special Ground Safety Plans (identified on a case by case basis for especially hazardous operations) will wear personal protective gear as indicated in the Ground Safety Plan.

4.0 **OPERATIONAL CONTROLS AND SECURITY**

For all launch operations at NSBF, Ft. Sumner and remote sites, the designated Campaign Manager, or at NSBF the Flight Director, exercises control over personnel associated with the operation.

4.1 All NASA personnel, NSBF personnel, experimenters, scientists, and associated contractors are responsible for:

- Adhering to the requirements established in this document.
- Adhering to the directions issued by the NSBF designated Flight Director or Campaign Manager.
- Reviewing vehicle, payload, support systems, and support operations with the Flight Director or Campaign Manager.
- Obtaining permission from the Flight Director or Campaign Manager before conducting any operations in hazard areas.
- Identifying active essential personnel for such operation to assure maximum personnel limits are not exceeded.
- Controlling all RF radiation sources in coordination with the Campaign Manager or Flight Director.

4.2 The designated Launch Crew Chief is responsible for all personnel access to the hazard areas defined for balloon operations.

4.2.1 Due to the extended distances involved with balloon launch operations, all NSBF personnel are expected to be alert to the presence of unauthorized and/or unescorted personnel in operational hazard areas and ensure that notification is provided to the Launch Crew Chief and that they are asked to leave the area.

4.2.2 NSBF Operations personnel will either be approved to work independently in the hazard areas or will be under direct supervision by senior personnel.

4.3.3 NSBF Operations personnel will utilize individual handi-talkie radios for direct communication with the Launch Crew Chief.